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F I F T I E T H A N N I V E R S A R Y

Lewis Research Center *Cleveland, Ohio*

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Remembering the Past, Challenging the Future

Originally built to study piston aircraft engines in the days of the National Advisory Committee for Aeronautics (NACA), Lewis Research Center has grown to be one of the world's most respected centers for aerospace research and development.

Let us take time out during this 50th Anniversary celebration to reflect on why Lewis has enjoyed so much success through the years. When America entered World War II, much of Lewis was a muddy construction site. Yet employees worked mandatory 48-hour weeks and went without holidays as they strove to improve the engines of military fighter aircraft. Because of their efforts, Lewis contributed to the successful conclusion of the war.

As the focus of research changed from piston engines to turbojet engines in the 1950's, the Lewis staff embraced the challenge of a new technology. With the dawn of the space age in the late 1950's, Lewis became part of the new National Aeronautics and Space Administration (NASA). In the 1960's, Lewis worked to perfect the use of liquid hydrogen rocket fuel, paving the way for manned space flight.

Throughout the years of budget cuts and reductions in staff, Lewis persevered. As the number of contractor employees grew, Lewis enjoyed a diversity in its work force not evident in the early days. Aggressive hiring of women and minorities brought new ideas and new views to Lewis. Only through the dedication of its employees has Lewis achieved so many advances in aerospace technology.

Lewis has much to be proud of. During the past 50 years, Lewis helped win World War II, made jet aircraft more efficient and safer, helped Americans land on the Moon, improved satellite communications, and engaged in the type of fundamental research that benefits all of us in our daily lives. In the future, the people of Lewis will continue to use their experience and innovative thinking to improve air travel, develop new materials and processes, and lay the technological foundation needed for humans to live and work in space.

Happy Anniversary, Lewis. Here's to the next 50 years.

L.J. Ross
Director
Lewis Research Center

The Wright Brothers' historic manned flight in 1903 launched a revolutionary new way to travel—by air. On March 3, 1915, a joint resolution of Congress established the National Advisory Committee for Aeronautics (NACA) "... to supervise and direct the scientific study of the problems of flight, with a view to their practical solution." For its first five years in operation, the unpaid 12-member committee had an annual budget of $5000.

The NACA brought many innovations to aviation in the 1920's and 1930's, including retractable landing gear and other refinements that helped to increase air speed. In 1924, George W. Lewis, a mechanical engineer and former faculty member of Swarthmore College in Philadelphia, became the NACA's Director of Research.

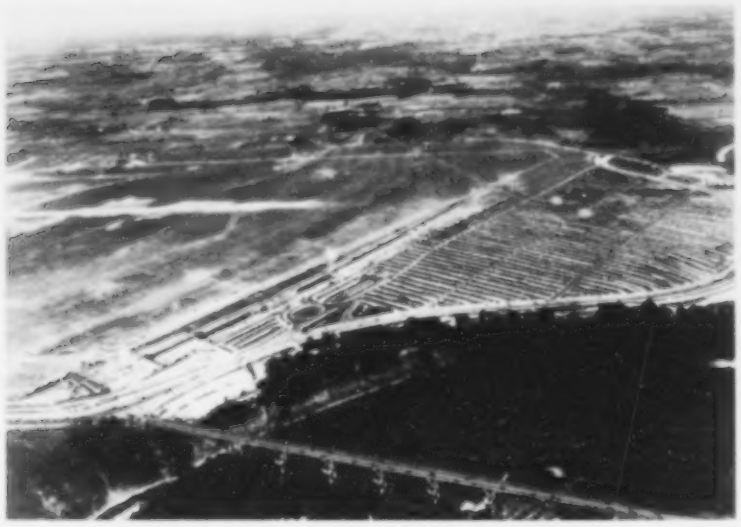
"... to supervise and direct the scientific study of the problems of flight, with a view to their practical solution...."

By 1930, the use of private, commercial, and military aircraft was well established in the United States. Testing at the NACA's Langley Aeronautical Laboratory in Virginia helped make airplanes fly better and operate more safely. But war was looming in Europe.

Concern about Germany's advanced military aircraft prompted an NACA special committee, chaired by Charles Lindbergh, to recommend that a national engine research laboratory be built in the United States. Congress approved $8.4 million in funding for the new laboratory as part of the First National Defense Appropriations Act in June 1940.

To select the site, a special committee of NACA members, headed by Dr. Vannevar Bush, used an elaborate rating system based on such factors as weather, water and electric power availability, airport size, access to engine manufacturers, and vulnerability to attack. The committee ranked Cleveland number 1 of 72 sites in 62 cities.

The committee's selection of Cleveland was due largely to the efforts of the Cleveland Chamber of Commerce and its president, Frederick C. Crawford, who made as many as ten trips to Washington to help secure the laboratory for Cleveland. As president of



Site of the world-famous National Air Races, held in Cleveland throughout the 1930's—soon to be the Aircraft Engine Research Laboratory.

George Lewis addressing the staff on May 8, 1942, to mark the first day of research at the Laboratory.

The crew of the World War II bomber Memphis Belle *at the Hangar in 1944.*

Thompson Products, Inc. (later TRW), Crawford knew that a government lab would be good for Cleveland business. When electric power costs became a major issue, he stepped in to negotiate a last-minute agreement between the NACA and the Cleveland Electric Illuminating Company.

The 200-acre site chosen for the new Aircraft Engine Research Laboratory was well steeped in aviation tradition. Throughout the 1930's, crowds of people gathered to watch daring flyers such as Roscoe Turner, Amelia Earhart, Jimmy Doolittle, and Charles Lindbergh, and to hear the roar of the planes sweeping past the grandstands of the world-famous National Air Races.

The Mayor of Cleveland, Harold H. Burton, agreed to sell this piece of land at the west end of the Cleveland airport to the federal government for $500. The original building plans called for a test hangar, an administration building, an engine research laboratory, a fuels and lubricants building, and an altitude wind tunnel.

On January 23, 1941, a brief groundbreaking ceremony at the site marked the start of construction. George Lewis, instrumental in convincing Congress of the need for an engine research laboratory, loosened the soil with a chromium-plated pick. Major General George H. Brett, a native of Cleveland, turned the first shovelful of earth.

The bombing of Pearl Harbor and the U.S. declaration of war in December 1941 brought a new sense of urgency to completing the test facilities. On May 8, 1942, research began at the Aircraft Engine Research Laboratory. A propeller test of the troublesome R-2600 Wright Cyclone piston engine was the first of many tests conducted to improve the engines of America's fighter planes during World War II.

The Altitude Wind Tunnel, at the time of its completion in 1944, was the only known wind tunnel designed to test aircraft engines at simulated altitude conditions. The tunnel proved to be a challenge in design and construction. The unique refrigeration system used to simulate the cold temperatures found at high altitudes was designed and built by Carrier Corporation, well known for its air conditioners.

As part of the Altitude Wind Tunnel complex, the Icing Research Tunnel was designed to test airplane components in simulated icing conditions to minimize risky test flights into actual icing clouds. Not until the spray system was redesigned around 1950 could the Icing Research Tunnel achieve icing conditions comparable to nature.

During the 1940's, life at the Lab was hectic. Until the end of World War II, employees worked six days a week, with one holiday—Christmas. Gasoline rationing made car pooling commonplace. Employees worked together and played together. A social organization, the NicNACA, planned dances and other social events. The Lab newsletter, *Wing Tips*, kept the staff up-to-date on who was getting married and who was on vacation, and encouraged submissions of baby pictures. Director Ray Sharp was not satisfied to oversee operations from his office in the Administration Building—he spent much of his time touring the Lab and visiting with the staff.

The Lab was an important wartime tour stop for military leaders, aviation writers, and government officials. War bond drives brought many noted visitors. In 1944, the crew of the *Memphis Belle* showed off their famous fighter plane at the Hangar. Actress Dorothy Lamour toured the Lab and posed for photographs with NACA personnel.

Women played an important role at the Lab during the war years.

Because much of the male work force was overseas, women had the opportunity to work in positions normally held by men. In response to a *Wing Tips* discussion topic, Do you favor employing more women?, technical editor Pearl Young wrote, "As a peacetime policy, I would recommend that professional women be given . . . equality with men as regards rating, promotion, salary, and responsibility . . . . " But even this far-thinking professional felt that women employed as part of the war effort should understand "that their employment is temporary and that after the war they will have to surrender their jobs either on account of curtailment of war activity or to give employment to men discharged from the Army."

Although the Aircraft Engine Research Laboratory was built primarily to test piston engine performance, a new technology was emerging that promised to change the face of aviation forever—jet propulsion. In 1943, cloaked in secrecy, a General Electric turbojet engine was brought to the Cleveland Lab for testing. In 1944, when the Altitude Wind Tunnel was ready for testing, it was the General Electric jet engine, not a piston engine, that made the first test run.

" . . . I would recommend that professional women be given . . . equality with men as regards rating, promotion, salary, and responsibility . . . . "

— Pearl Young

After the war, jet engine research took priority. The NACA recruited German scientists and studied their technology. Engineers at the Lab examined the dreaded V-1 buzz bomb that wreaked havoc in London during the war. They began developing a simpler jet-propelled device, the ramjet, which would be tested extensively at the Lab.

Recording air pressures from a manometer tube bank.

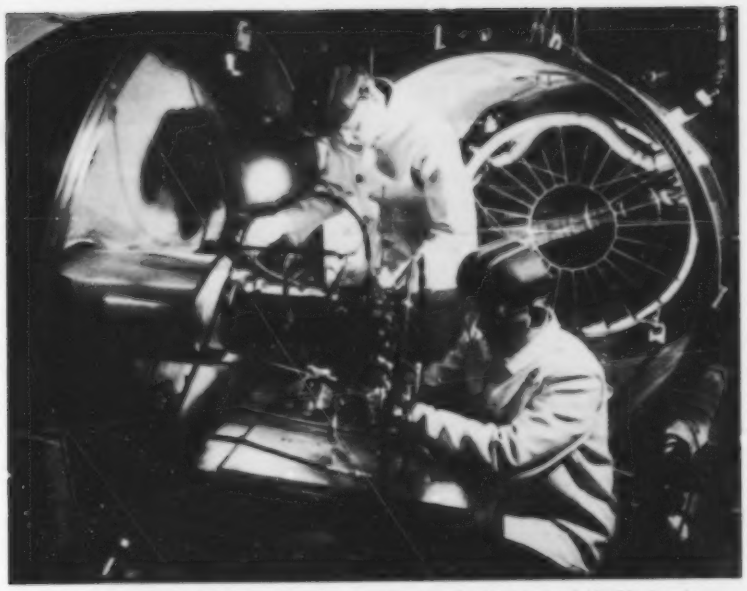
The Jet Propulsion Static Laboratory, where secret testing of General Electric's new turbojet engine began during World War II.

Full-scale crash fire testing at the Ravenna Arsenal.

Even before Chuck Yeager flew faster than the speed of sound in his Bell X-1 aircraft in 1947, plans were under way to build an 8- by 6-foot supersonic wind tunnel. Early work with liquid hydrogen and nuclear propulsion led the way for major research programs in the coming years.

After the death of George Lewis in 1948, the Lab was named, in his honor, the Lewis Flight Propulsion Laboratory. In his address at the commemoration ceremony on September 28, 1948, Vice Admiral Emory S. Land said, " . . . it has been determined to bestow upon this great laboratory the imperishable name of the Lewis Flight Propulsion Laboratory—that it shall always be a reminder of him who created it."

As work on the jet engine wound down in the 1950's, the Lewis Laboratory turned to other pursuits. The Icing Research Tunnel's newly designed spray system reproduced the tiny droplets found in a natural icing cloud, and allowed for extensive



Ion engine being installed in a vacuum chamber. In the 1950's and 1960's, Lewis researchers studied electric propulsion systems for long-range space voyages to Mars and beyond.

Lewis physicist studying alpha particles in a cloud chamber. The paths of particles are visible as white streaks. These cloud streaks, or tracks, helped scientists to learn more about the nature and movements of such particles.

NACA test pilot.

testing of aircraft components. The hot-air anti-icing technology used on today's airplanes can be traced to work done at the Icing Research Tunnel in the 1950's.

As part of Lewis' Crash Fire Program, the NACA conducted full-scale crash tests at the Army's World War II arsenal in Ravenna, Ohio. Airplanes were instrumented to record temperatures and other data and then sent down the runway by remote control to crash into a barrier. Today's airplanes are safer as a result of this research.

"... it has been determined to bestow upon this great laboratory the imperishable name of the Lewis Flight Propulsion Laboratory."

— Emory S. Land

In 1956, Lewis leased land near Sandusky, Ohio, for a nuclear reactor facility to test nuclear-powered aircraft. Once the site of an explosives factory and ammunition storage during World War II, the area was designated Plum Brook Station and used for testing throughout the

1960's for full-scale rocket testing and other research.

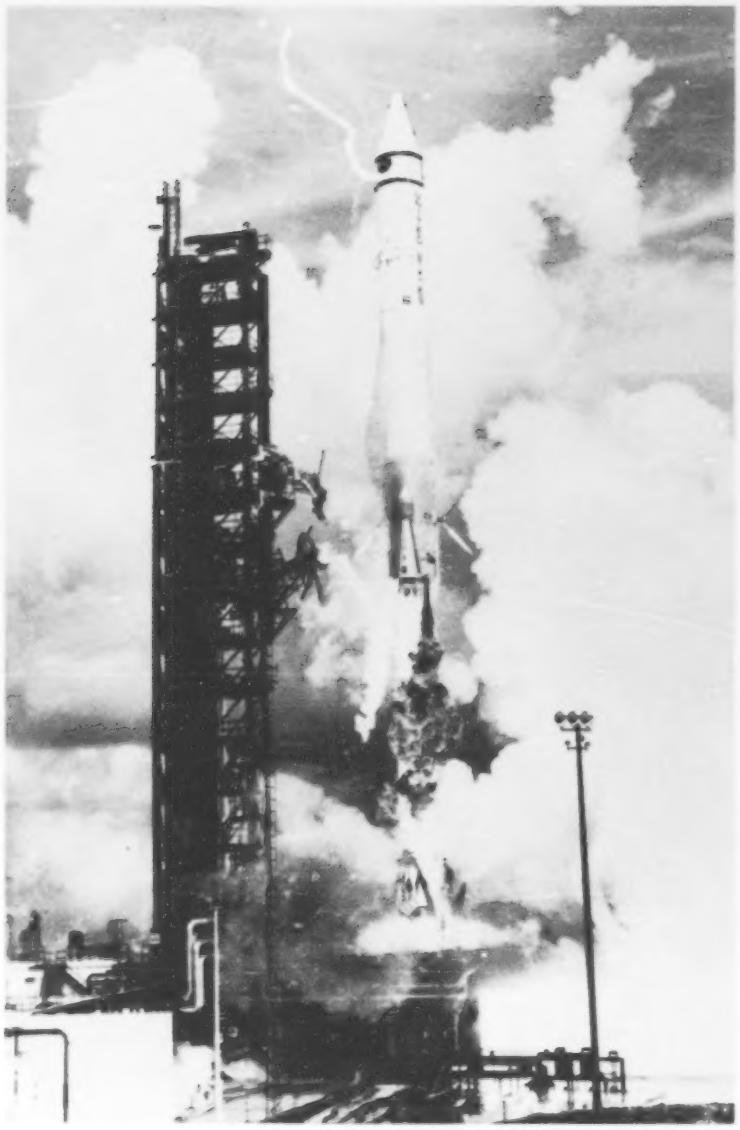
Liquid hydrogen rocket fuel was studied by a small, but determined, group at Lewis during the 1950's. Thought by many experts to be too dangerous to work with, liquid hydrogen could provide more thrust than other rocket fuels like hydrazine and ammonia. The rocket group felt that the possibilities outweighed the risks and worked hard to convince NACA management of the importance of rocket research.

In 1957, the Lewis Laboratory began preparations for its triennial inspection in October. The NACA inspection, a full-blown affair, showcased important research for hundreds of politicians and business executives. That year, Lewis leaders planned the inspection as a tribute to the 10th anniversary of Chuck Yeager's supersonic flight and the great advances in aeronautics during the last 10 years.

In September, NACA officials visited Lewis for a rehearsal of the inspection presentations. John Victory, Executive Secretary of the NACA, was hesitant to offend Congress with budget-busting experiments for unearthly pursuits. He asked that all references to space be removed. But on October 4, the world of the NACA changed forever—the Russians launched Sputnik, the world's first artificial satellite. It was time, not to look back on accomplishments, but to forge ahead into new, unexplored territory. Lewis was ready—the presentations on high-energy rocket propellants and their application to space exploration were the highlight of the inspection.

On March 5, 1958, President Eisenhower announced the organization of a new space agency to be called the National Aeronautics and Space Administration. Abe Silverstein, who helped plan the new agency, accepted the position of director of the NASA Office of Space Flight Programs and headed for Washington to oversee the manned Mercury program. On October 1, 1958, the NACA was dissolved. The Lewis Lab officially became part of NASA and took the name Lewis Research Center.

As the Mercury program came into the forefront of the NASA agenda, Lewis became involved

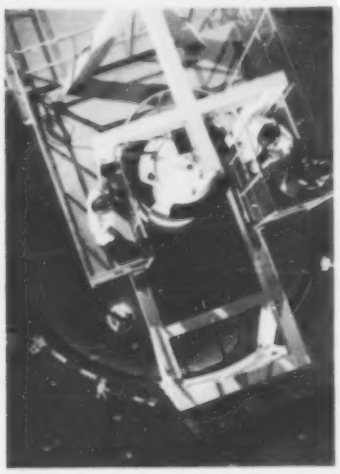


Successful launch of the Atlas/Centaur rocket on August 11, 1965.

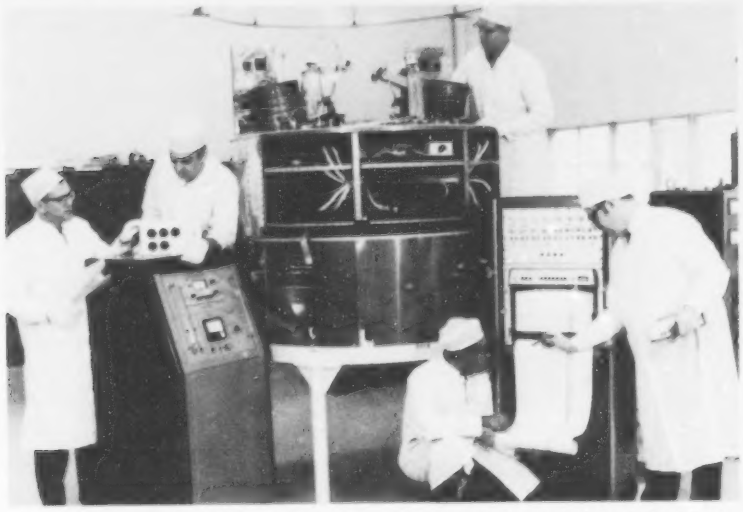
with several projects associated with the program. In 1959, the Mercury astronauts trained at Lewis' Multiple-Axis Space Test Inertia Facility (MASTIF), which subjected the astronauts to the same type of spinning and rolling motions they might experience in space.

President John F. Kennedy announced in May 1961 that America would land a person on the Moon within the decade. He said, "No single space project in this period will be more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish." There was little time for NASA to develop the complex technology needed for the flight.

Mercury astronaut John Glenn during his training at Lewis in 1960.



The 500-foot-deep Zero Gravity Research Facility, built in 1966.

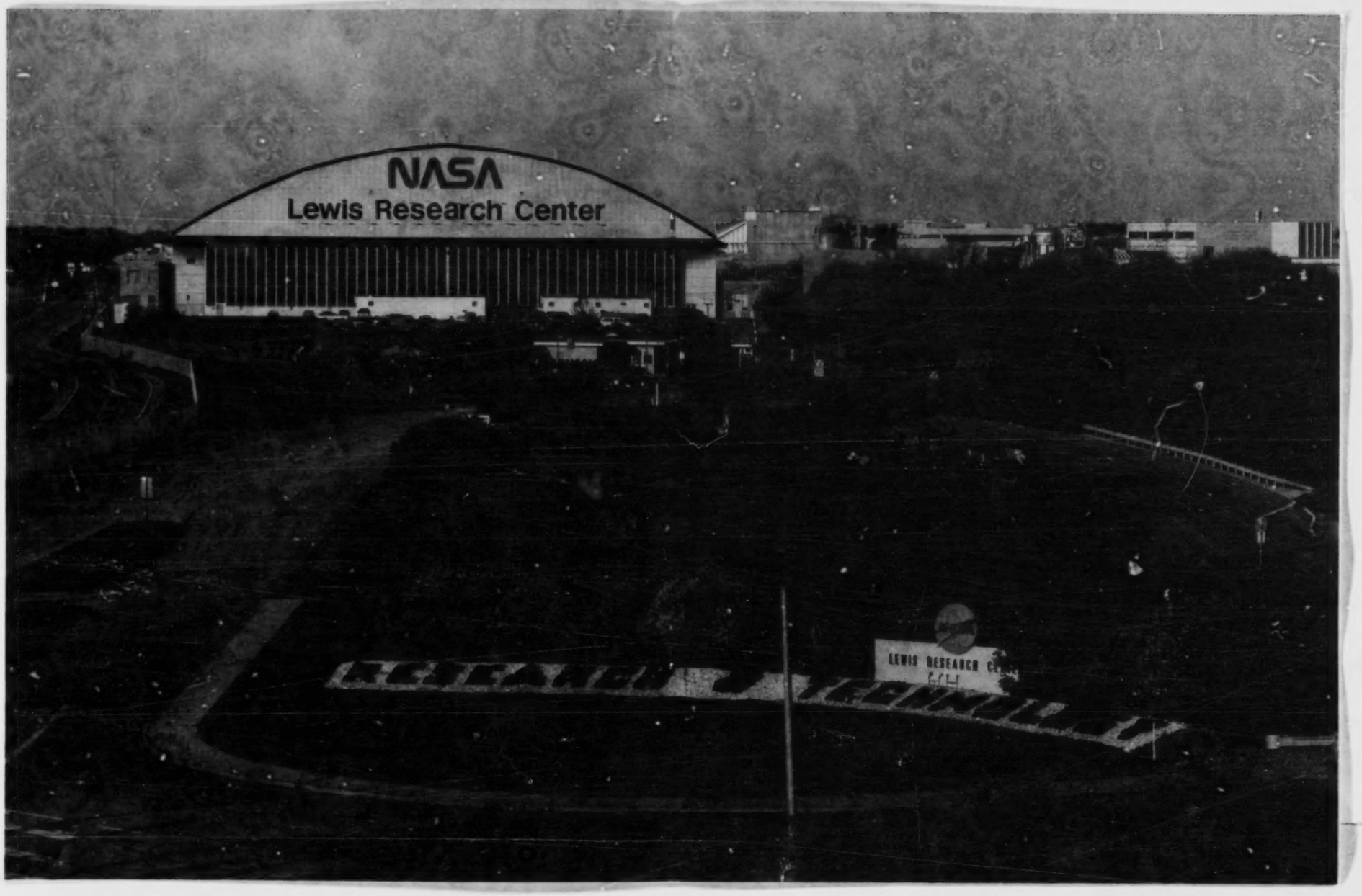


The SERT II (Space Electric Rocket Test) spacecraft in the clean room of the 8- by 6-Foot Supersonic Wind Tunnel. This electric rocket was launched in 1970 primarily to test its two ion propulsion thrusters. Expected to be active for about a year, the SERT II is still in orbit and provides, from time to time, valuable data on the effects of space on its components.

Since the Moon mission would require a rocket with great thrust, America's hope for landing someone on the Moon rested on the performance of the Centaur rocket, an upper-stage rocket fueled by liquid hydrogen. Because of their experience with this dangerous fuel, Lewis engineers were offered the Centaur Project.

Abe Silverstein chose to return to Lewis as Director after Ray Sharp retired in 1961. At Lewis, Silverstein could personally take charge of the Centaur Project and ensure its success. In 1963, the Atlas/Centaur rocket was launched successfully, the first of over 100 Centaur flights in the years to come. The Atlas/Centaur rocket launched the unmanned Surveyor probes, which made soft landings on the Moon to collect data before the Apollo flights, and the Orbiting Astronomical Observatory (OAO), which gave the first hard evidence of black holes in space.

In the late 1960's, with the manned missions taking the lion's share of the budget, Lewis was forced to reduce staff and cut back on its research programs. As Neil Armstrong took his first step on the Moon in 1969, a feat due in part to Lewis' work on the Centaur rocket and liquid hydrogen fuel, Lewis began a fight for its life. Times changed, and public support for the huge sums of money NASA needed to continue its research waned. When Abe Silverstein retired in 1969, Bruce T. Lundin had his work cut out for him as he accepted the directorship of Lewis Research Center.


NASA
Lewis Research Center

In the 1970's, Lewis lost hundreds of civil service positions. Plum Brook Station was slated to close. Programs were canceled. But Lewis hung on. The Center continued to manage the Atlas/Centaur program, and, in addition, the Titan/Centaur, which launched Mariner and Viking probes to Mars. The Communications Technology Satellite (CTS) program greatly improved communications satellites.

The focus at Lewis, however, was turning to Earth-based technology. Once devoted almost exclusively to the aircraft engine, Lewis returned to aeronautics and engine systems in the 1970's. Projects such as the Quiet Engine Program kept Lewis in business.

"If Lewis closes it means NASA is junking the first 'A' in its name. We'd become the National Space Agency and have nothing to do with aeronautics."

— The Cleveland Press

Public concern for pollution and massive energy consumption, coupled with dwindling supplies of fossil fuels, prompted funding for new programs. Lewis scientists worked with the Environmental Protection Agency (EPA) in pollution studies of Lake Erie and investigated processes for producing cleaner burning coal.

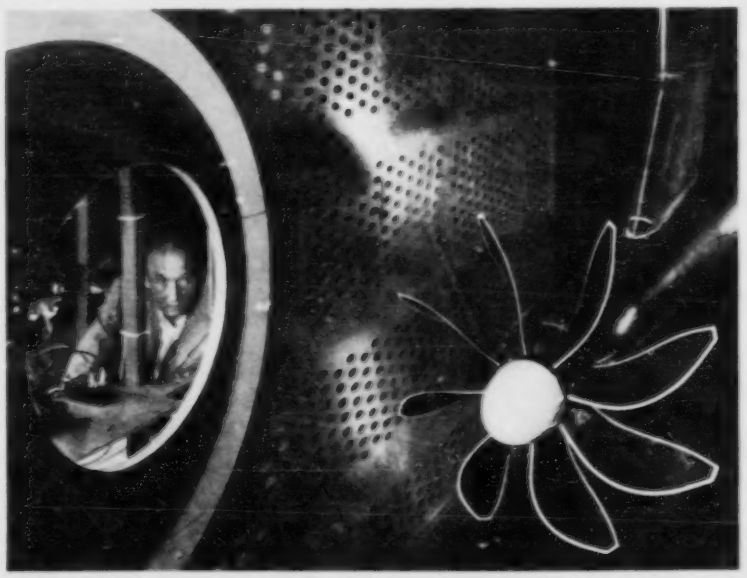
Alternate forms of energy, such as solar power and wind power, were studied extensively. Lewis engineered the first solar-powered village, for the Papago nation in Arizona. In partnership with the Department of Energy, Lewis engineers perfected the wind turbine, a high-tech windmill.

Working to conserve aircraft fuel, Lewis staff began the Advanced Turboprop Project to design an aircraft powered by a propeller and gas turbine engine. Lewis also sought fuel-saving innovations for the automobile engine.

After Bruce Lundin retired in 1977, rumors flew that Lewis would be closed. But in 1978, John F. McCarthy, Jr., was hired as Director. Past Director of the Center for Space Research at Massachusetts Institute of Technology, he aggressively hired women and other minorities, and began a promotional campaign to boost Lewis' image with the public. McCarthy reached out to the politicians in Washington and canvassed for support.

The 1980's brought more budget woes to Lewis. Again, there was talk that Lewis would close. One budget study determined that aeronautical research by the federal government was unnecessary because the aircraft industries could do their own research. A source in an October 1, 1981, *Cleveland Press* article said, "If Lewis closes it means NASA is junking the first 'A' in its name. We'd become the National Space Agency and have nothing to do with aeronautics."

Mathematician Annie Easley. During her 34 years at Lewis, she achieved recognition for her active participation in Equal Employment Opportunity and other programs.



Turboprop model in the 8- by 6-Foot Supersonic Wind Tunnel. The Advanced Turboprop Project won the 1987 Robert J. Collier Trophy for great achievement in aeronautics.

The 100-kilowatt Mod 0 wind turbine constructed in 1975 at Plum Brook Station. Early problems with excessive stresses and turbulence were solved by removing the interior stairs and installing a cable elevator.

The Nuclear Research Reactor Facility at Plum Brook Station, completed in 1961. The pie-shaped quadrants were filled with 25 feet of water during reactor operation.

Design concept for the National Aerospace Plane, or X-30. Part airplane, part spaceship, the X-30 leads the way for the space planes of the future.

In 1982, John McCarthy resigned as Director, to be replaced by Andrew J. Stofan. Fresh from an appointment as Deputy Associate Administrator for the NASA Office of Space Sciences, Stofan knew how important it was to keep up communications with Washington, and he felt that Lewis could play a major role in space research.

In mid-1982, Lewis received a 50-percent increase in its budget for projects such as an upper-stage propulsion system for the space shuttle, advanced communications satellites, and the Galileo spacecraft, which would travel to Jupiter and send probes to the planet's surface. Rumors of Lewis' closing were put to rest as NASA administrators and politicians alike vowed to support the important work being done at Lewis.

Major programs on Lewis' agenda in the 1980's were power systems for the yet-unnamed space station, the Advanced Turboprop Project, refurbishing of the Icing Research Tunnel, and advanced communications satellites. Energy research was phased out in the 1980's.

In 1987, Lewis received an Emmy award for contributions to television technology through improved satellite communications. In addition, Lewis received the Robert J. Collier Trophy for the year's greatest achievement in aeronautics, the Advanced Turboprop Project; and the Icing Research Tunnel was designated an International Historic Mechanical Engineering Landmark by the American Society of Mechanical Engineers.

The year 1987 was also one of administrative change—John M. Klineberg assumed departing Andrew Stofan's position as Director.

With Lewis' plans for the future firmly established, Plum Brook Station reopened, and its Space Power Facility, at one time the world's largest vacuum chamber, was leased to private companies for testing. The Power Systems Facility, a building intended for the research and development of the power system for Space Station Freedom, was completed in 1989. Lewis was ready for the 1990's.

The new decade brought to Lewis, among other things, a new director—Lawrence J. Ross, who took

over when John Klineberg accepted the directorship of Goddard Space Flight Center in Maryland. Ross has worked to ensure that Lewis Research Center keeps a high profile in the community. The challenge of new programs, successes in current programs, and expanding research facilities in the Lewis area have combined to make Lewis' future an exciting one.

Aeronautics studies at Lewis include work to improve engine efficiency and reduce noise. Lewis engineers are making supersonic cruise aircraft less costly to run and safer for the environment than existing supersonic aircraft like the Concorde. Researchers at Plum Brook Station are testing the use of slush hydrogen as fuel for the National Aerospace Plane, a vehicle that will be able to take off on a runway, travel faster than five times the speed of sound, achieve orbit, and then land at any major airport. Nuclear and electric propulsion, studied at Lewis in the 1950's and 1960's, are making a comeback.

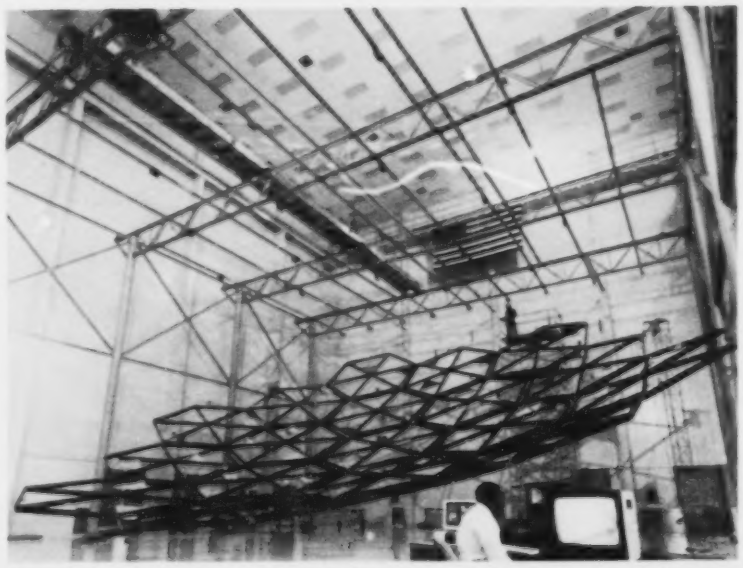
In aerospace technology, Lewis is working to develop solar concentrator arrays for space power systems. The arrays will collect and concentrate sunlight for conversion to electrical power. Researchers at Lewis are increasing the life of battery cells for lower-cost power in space. Work in space electronics is expanding to include expert (intelligent) systems which can help detect, isolate, and diagnose problems, or schedule loads for more efficient use of available power.

Developing the electrical power system for Space Station *Freedom* is a major project at Lewis. Although scaled down from its original design, the station will challenge Lewis engineers with its complex energy requirements. The power modules, which will track, capture, and store the Sun's energy, must be assembled and maintained by astronauts in the weightless environment of space. Underwater assembly testing of the power system at Johnson Space Center will make sure the components can be easily assembled in space.

Enjoying the Apollo Skylab III command module displayed at the Visitor Center. More than 100,000 people tour the Visitor Center each year.

Control room for the Icing Research Tunnel.

Testing a Stirling engine, which can efficiently convert solar energy to electric power.



A solar concentrator designed for use on Space Station Freedom. The $6.1 million Power Systems Facility, completed in 1989, is the first new building at Lewis since 1980.

Students from East Technical High School in Cleveland admiring an award-winning science fair project. Lewis employees helped organize the science fair as part of the Lewis/East Tech Partners in Education program.

Erecting a geodesic dome over the Powered Lift Facility to muffle the noise of nozzle testing. Lewis is committed to being a good neighbor to area residents.

Launching the Advanced Communications Technology Satellite (ACTS) from the space shuttle (artist's concept).

Work in space science includes microgravity experiments flown on the space shuttle. The Advanced Communications Technology Satellite (ACTS) being developed at Lewis will be able to service networks containing thousands of ground terminals. With a communications capacity three times that of a conventional satellite of the same weight, ACTS will greatly improve mobile, aeronautical, and shipboard satellite communications.

Researchers are also carrying on the Lewis tradition of studying basic disciplines such as materials science and technology, structural mechanics, life prediction, internal computational fluid mechanics, heat transfer, and instruments and controls.

A recent boom in aerospace-related development in the area is good news for both Lewis and the Cleveland community. Lewis helped establish the Ohio Aerospace Institute, a consortium of nine Ohio universities formed to promote aerospace research, graduate education, and transfer of technology. The institute will be located near Lewis' west gate and should be completed in late 1992. Near Lewis Research Center in Brook Park, Ohio, is the Aerospace Technology Park, a recent development designed to draw aerospace-related businesses to the area. Lewis on-site contractors Analex Corp., Sverdrup Technology, Inc., and Cortez III Service Corp. have leased buildings in the Park.

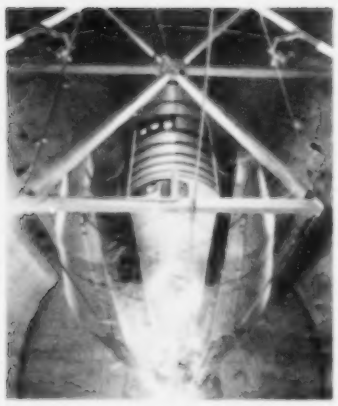
Throughout its history, Lewis has enjoyed a close relationship with the Cleveland community. Lewis' Visitor Center, a popular Cleveland attraction, has 8,000 square feet of exhibit space and gives up-to-date information about NASA programs and aerospace research. The Visitor Center is open seven days a week and most holidays. Admission is free and group tours are available. For more information, call (216) 433–2001.

The Lewis Teacher Resource Room helps teachers plan informative and fun lessons about aerospace for school children of all ages. The Lewis Speakers Bureau provides lecturers for presentations on many aerospace topics to civic and professional groups.

Lewis also sponsors the Summer High School Apprenticeship Research Program (SHARP), which gives minority high school students a chance to work in a research environment. Lewis encourages new ideas from small or minority-owned businesses, and has a trades apprentice program.

Lewis employees are active in student-mentoring programs that stimulate interest in math and

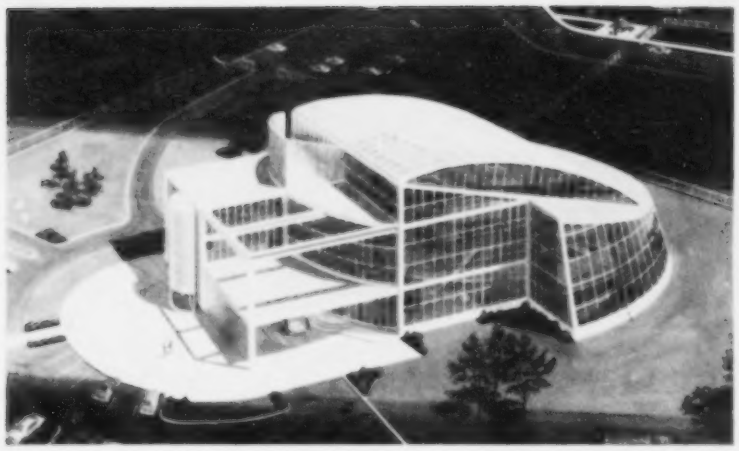
The Space Shuttle Discovery returning from space with Lewis' Solid Surface Combustion Experiment, designed to study the way flames spread in low gravity.



Shroud separation testing at Plum Brook's Space Power Facility. This testing can determine the flight readiness of new launch vehicles that release payloads such as weather satellites into orbit.

science, and they donate their time to produce an annual Christmas show for Cleveland school children.

Over the years, Lewis has expanded to 350 acres, with over 150 buildings. Lewis has changed from a self-contained government laboratory to a research center fully integrated with the business and academic communities. About 5,000 people, both civil service and contractor personnel, work at Lewis. In fiscal year 1990, Lewis' budget was $840 million, including contributions of $199 million in contracts and grants. Lewis' operating budget for 1991 is $995 million.

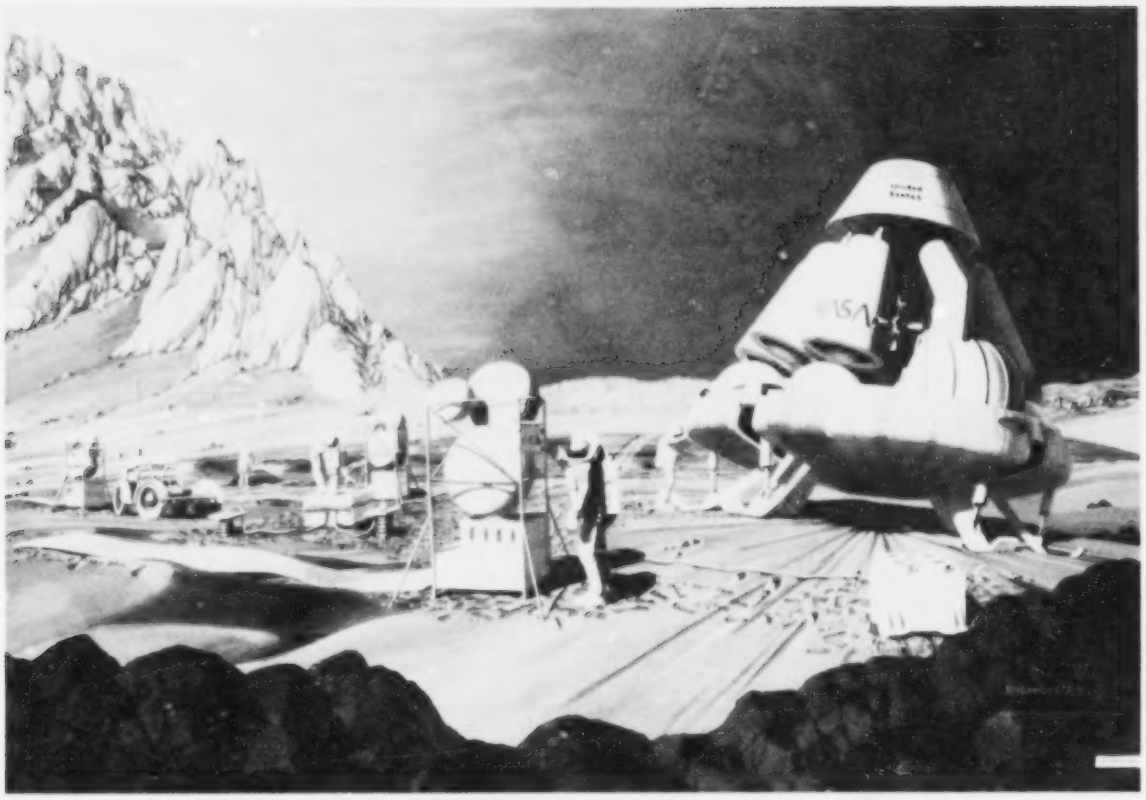


Artist's rendering of the Ohio Aerospace Institute.

Recently hired employees in the Space Electronics Division. New employees such as these will use their unique talents to carry on the tradition of excellence and innovation at Lewis Research Center.

In 1989, on the 20th anniversary of the Apollo 11 Moon landing, President George Bush announced a bold plan for the 1990's and beyond. His Space Exploration Initiative outlined a long-range commitment to human exploration of space: "first, for the coming decade—for the 1990's—Space Station *Freedom*—our critical next step in all our space endeavors. And next—for the new century—back to the Moon. Back to the future. And this time, back to stay. And then—a journey into tomorrow—a journey to another planet—a manned mission to Mars."

As Lewis stands poised to enter the 21st century, its future looks bright. With a commitment to excellence and a culturally diverse work force challenged by exciting new programs, chances are good that Lewis will be around in the year 2041 to celebrate its 100th Anniversary.



"A journey into tomorrow—a journey to another planet—a manned mission to Mars."—President Bush's Space Exploration Initiative.

The time capsule commemorating Lewis' 50th Anniversary. Dedicated on January 23, 1991, the capsule will remain sealed until Lewis' 100th Anniversary in 2041.

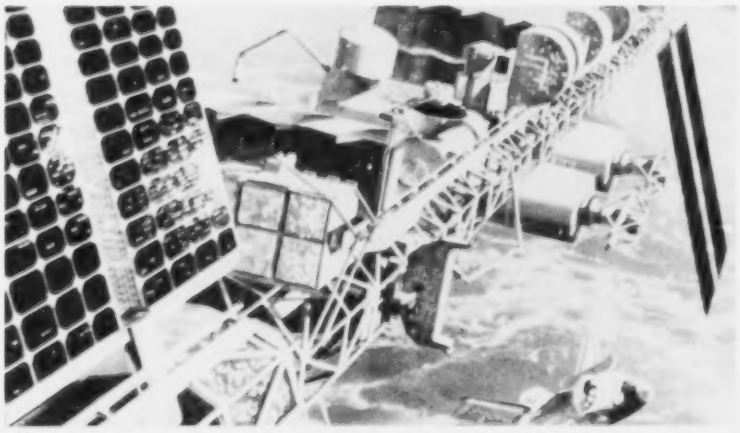


Illustration of the restructured Space Station Freedom *as recommended by the NASA/White House Advisory Committee on the Future of the U.S. Space Program.*

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Lewis Research Center has a remarkable history. The 50th Anniversary year is the perfect time to remember all the people and the projects that, over the years, have helped to shape our world. From the hectic days of World War II, through the exciting years of the space race and the lean years to follow, to the 1990's, Lewis has been at the forefront of technology. In this commemorative publication, I have tried to capture the essence of Lewis—its people, its innovative research programs, and its binding ties with the Cleveland community. Any omissions of important programs or key people is purely a consequence of limited space.

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